



Guidelines for Managing Bicknell's Thrush Habitat in the United States



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Introduction

Species profile

Bicknell's thrush is one of the most rare and range-restricted songbirds in the United States, breeding only at upper elevations in New York and northern New England.¹ Isolated patches of habitat extend along the Laurentian and northern Appalachian highlands into southeastern Canada and include a diminishing number of Atlantic coastal sites.²

Bicknell's thrushes typically nest in dense, low-canopy forests dominated by balsam fir, but they also breed in paper birch-balsam fir sapling stands following timber harvest or fire.^{3,4} Beginning in early October, adults and young migrate to the Greater Antilles, where most winter on the island of Hispaniola in high-elevation broadleaf forests of the Dominican Republic.^{5,6}

Bicknell's thrushes resemble other northeastern forest thrushes (Fig. 1), but can be readily distinguished by their unique songs and calls. They forage on the ground and in low vegetation for invertebrate prey and also consume fruits when they are available.^{6,7}

Status and conservation concerns

Bicknell's thrush is a Species of Greatest Conservation Need and a special concern species in New York, Vermont, New Hampshire, and Maine. Canada has designated it as threatened under the Species at Risk Act, while Partners In Flight considers it to be among the highest bird conservation priorities in North America. Concerns center on its small population size, limited breeding and wintering distributions, and continuing deforestation of non-breeding habitat, particularly on Hispaniola.^{8,9} Local extirpations in several states and provinces and severe declines in Nova Scotia have added a sense of urgency to conservation efforts.^{2,10,11}

A population decline observed in the White Mountains between 1993 and 2003¹² appears to have been followed by a period of recovery.¹³ Surveys from 2001 to 2010 found stable to increasing numbers across most of the northeastern US, except in the southern Green Mountains.¹⁴

As the climate warms, encroachment of northern hardwoods on high-elevation fir and spruce could eventually reduce the extent of Bicknell's thrush breeding habitat.¹⁵ However, such a change is likely to be slow and inconsistent due to the many factors that affect mountain ecotones.¹⁶ A more immediate risk may be an increase in aggression and competition from Swainson's thrush.^{17,18} This species, which is less tolerant of cold than Bicknell's thrush,¹⁹ has shifted upslope in recent years²⁰ and become more abundant in Bicknell's thrush habitat.¹⁴ It is not clear whether this shift will affect Bicknell's thrush populations.

Other potential stressors on the breeding grounds include mercury contamination²¹ and disruption of the balsam fir masting cycle, which could result in consistently higher rates of nest predation by red squirrels.²² By comparison, habitat removal and alteration could influence Bicknell's thrush populations more directly. Although most US breeding areas occur on conserved lands, recreational development, wind energy facilities and commercial timber management are permissible in some habitat units. Effects of these activities vary with the type and scale of disturbance as well as the broader landscape context.



Figure 1. A Bicknell's thrush delivering food to its young.

Purpose of the guidelines

The purpose of these guidelines is to promote the habitat conditions and processes that sustain Bicknell's thrushes and other disturbance-adapted mountain birds in the US Northeast. They may be useful to stewards of high-elevation forests who wish to identify, maintain, or restore habitat. The guidelines are also intended for foresters and loggers who work in Bicknell's thrush breeding areas, although these sites are limited in the US due to regulatory and practical constraints on harvesting at upper elevations. A common understanding of the habitats and practices that benefit this vulnerable species will help secure its future as an icon of the Northeast's most remote forests.

Where to Create and Sustain Habitat

Landscape characteristics

Efforts to maintain or create Bicknell's thrush habitat should focus on periodically or chronically disturbed forests located above an elevation threshold that decreases by approximately 270 ft for every one-degree increase in latitude, from 3,425 ft in the Catskills to 2,300 ft in northern Maine (Fig. 2).¹ Bicknell's thrush populations in the Adirondack, northern Green, and White Mountains generally occur above 3,000 ft, with highest densities between 3,700 and 4,600 ft.^{1,14,23,24}

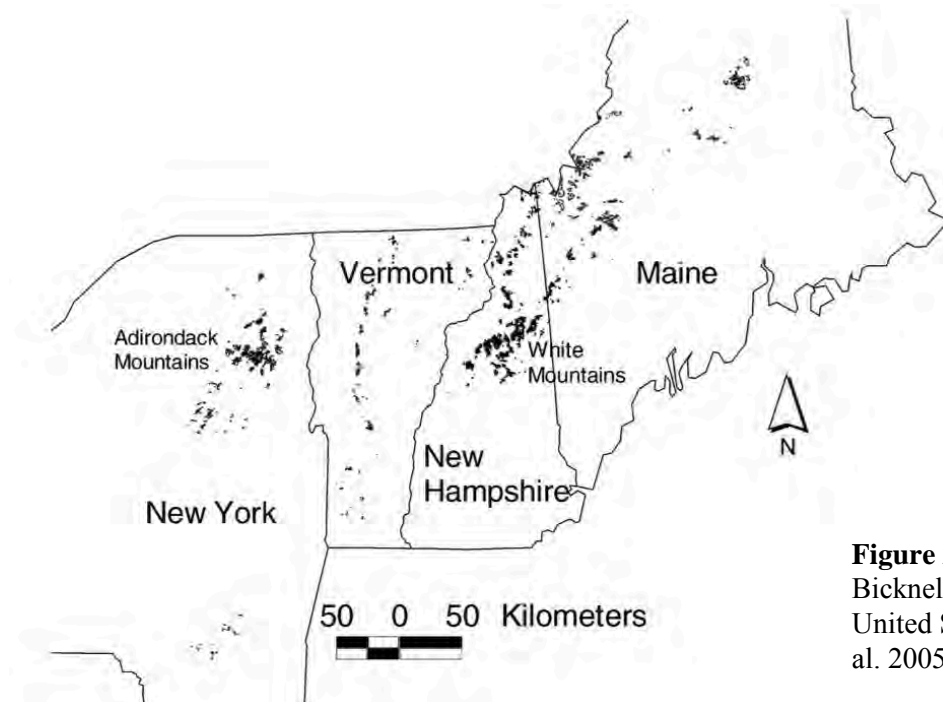


Figure 2. Predicted distribution of Bicknell's Thrush in the northeastern United States (reprinted from Lambert et al. 2005).

The upper and lower limits of Bicknell's thrush habitat are influenced by the continental climatic gradient, as well as site-specific factors that govern forest structure, such as topography, soil characteristics, and exposure to disturbance. Forests that are shaped by wind, ice, or regular timber harvesting are more likely than undisturbed areas to provide a steady supply of suitable habitat (Fig. 3). Bicknell's thrushes may even occur in stands below the elevation threshold if a recent canopy disturbance has stimulated dense understory growth.²⁵ Such stands may warrant consideration for experimental habitat treatments, particularly if future studies produce evidence of successful breeding in regenerating harvest zones.



Figure 3. Forests growing on steep slopes with shallow soils (l) are prone to natural disturbances that generate vigorous understory growth. Suitable habitat may also develop on broad, boreal plateaus after a fire, spruce budworm outbreak, or timber harvest (r).

Sites with more than 10 ac of contiguous or clustered habitat should be sufficient to support a social group consisting of at least one female and two or more males. Habitat patches > 20 ac are very likely to be continuously occupied while those < 5 ac may only be used intermittently.²² Although large and connected habitat units offer the most value to Bicknell's thrush, spatial characteristics should not be the principal consideration in selecting sites for implementing these guidelines. In general, stand characteristics appear to influence Bicknell's thrush colonization and persistence rates more strongly than patch size and configuration.²⁶

Spatial assessments of Bicknell's thrush habitat have thus far produced models of current distribution¹ and landscape capability²⁷ for the entire US range, as well as estimates of occupancy and/or density for the White Mountain National Forest,²⁴ northeastern Vermont,²² and northwestern Maine.¹⁴ A forthcoming analysis of more recent and comprehensive field data will make available density and occupancy estimates for all of the states where this species breeds (J. Lloyd, pers. comm.)

Desired Habitat Conditions

Forest composition

Bicknell's thrushes primarily breed in balsam fir forests with lower levels of paper birch, mountain ash, and red spruce.^{6,17,28,29} White spruce may also mix in at northern latitudes.³⁰ While balsam fir predominates in the most productive breeding areas, red spruce, paper birch, and yellow birch tend to be more common in the lower band of sparsely occupied habitat that encircles high mountains.^{24,25} Regenerating paper birch and pin cherry stands may provide suitable cover during the breeding season,⁴ particularly if patches of balsam fir are present.³¹

Understory plants that occur in montane fir-spruce forests include mountain maple, striped maple, hobblebush, Bartram's shadbush, mountain wood fern, and bunchberry.³² Sphagnum mosses and horsehair fungus grow on the forest floor and are used for nesting material.³³

Forest structure

Bicknell's thrushes breed in forests with high densities of saplings or small trees, and low, open, or semi-open canopies, including multi-aged and even-aged stands. These areas occur as ephemeral patches undergoing forest succession after the canopy has been opened by wind-throw, snow or ice damage, timber harvest, insect outbreak, or fire. Persistence of suitable habitat is greatest at high elevations, where thin soils, short summers, and relatively frequent disturbance limit tree growth. Productive habitat also occurs along the edges of chronically disturbed openings, including ski trails, roadways, rockslides, and exposed ridges (Fig. 4). Wherever they breed, Bicknell's thrushes concentrate in patches of thick understory foliage and nest mainly in small balsam fir trees.^{2,6} They may preferentially select areas where forest structure is patchy³⁴ and where snags provide elevated and exposed song perches.^{24,26,35}



Figure 4. Bicknell's thrushes breed in dense thickets of balsam fir that grow along exposed ridgelines and sheltered trails. Snags provide valuable song perches, especially where canopy trees are absent.

Forests typically begin to provide suitable structure once the regenerating layer grows above 6 ft.^{31,36} Timing of succession is influenced by site factors, including soil characteristics, browsing pressure, and amount of retained understory; however, desired conditions are likely to develop 10-20 years after disturbance.^{4,34} Bicknell's thrushes have been observed in stands managed for wood products up to 40 years after harvest³⁵ and may be more abundant in areas where stand ages are mixed.³⁴ Recently thinned stands generally support lower densities than dense, regenerating stands.^{4,17,30,34,35}

Although habitat selection varies with context, the following attributes generally characterize Bicknell's thrush breeding habitat in the focal region.

- Saplings and small trees form densely foliated thickets that measure > 6 ft in height (Fig. 5).^{29,31,37}
- The density of small woody stems (< 4 in dbh) averages > 4,000 stems/ac and may range up to 25,000 stems/ac in patches used for nesting.^{28,29,31,34,36,38}
- Canopy trees may or may not be present. When they are, heights range from 15-30 ft on average, but sometimes reach up to 50 ft.^{28,29,39}
- Standing dead trees are present and may be abundant for use as song perches.^{24,26,28,29,35}
- Herbaceous plants are relatively sparse, enabling efficient ground foraging.^{7,28,34,36}
- Sphagnum moss and horsehair fungus are present, providing essential nesting material.^{6,33}



Figure 5. Bicknell's thrush habitat often features complex vertical structure and horizontal patchiness (l), however relatively uniform stands of regenerating fir also provide suitable cover for nesting (r). Snags serve as prominent song perches.

Recommended Practices

Appropriate measures to maintain or enhance Bicknell's thrush habitat will depend on ecological setting and locally prevalent land uses. Therefore, stewardship planning ought to involve natural resource professionals with local knowledge of wildlife values and forest dynamics. Environmental regulations will also shape site-based decisions, since most occupied areas occur in sensitive or protected mountain terrain. Although each project calls for a tailored approach, some of the following recommended practices may apply.

Land conservation

These recommendations are intended for conservation planners and land trust personnel interested in adding to the Northeast's already extensive network of conserved mountain lands. They may also be appropriate for designating reserves or special treatment areas in managed forest landscapes.

- Focus conservation resources on contiguous or clustered habitat patches > 20 ac, especially where low and dense forest structure is naturally maintained (*e.g.*, exposed ridges and steep, northwest-facing slopes).
- Favor areas where forests are most likely to be resistant to climate change, such as higher elevations on northern exposures or higher elevations at northern latitudes.
- Develop easements and stewardship plans that allow for forest management where it has potential to enhance or supplement Bicknell's thrush habitat. Limit this approach to areas that are sheltered from large disturbances, but already accessible via well-designed roads.

Forest management

These recommendations are intended for foresters and loggers operating in areas where access and growing conditions enable ecologically and economically sustainable forestry. They should not be applied to areas where climate or soil conditions strongly limit tree growth, including the region's highest mountain forests.

- Plan harvest intervals that ensure a continuous supply of sapling-dominated stands (Fig. 6). These areas may occur beneath open or semi-open canopies.
- Implement silvicultural systems and intermediate treatments that are most likely to promote or maintain high stem densities, balsam fir regeneration, and stand patchiness, such as: clearcutting with reserves, group shelterwoods, and variable retention thinning.



Fig. 6. In forests managed for wood products, unthinned stands (l) and stands thinned with variable retention are more likely than uniformly thinned stands (r) to provide productive breeding habitat for Bicknell's thrush.

- Where other management objectives call for uneven-aged or natural dynamics forestry, harvest trees in 0.5- to 2-acre groups or utilize an expanding-gap group shelterwood system. Cluster the harvests to emulate natural disturbance and increase the probability of occupancy by Bicknell's thrush (Fig. 7).
- When practical, retain other within-stand features that could enhance habitat quality for Bicknell's thrush, including snags (Fig. 8) and fruit-bearing trees, such as mountain ash.



Figure 7. Forest managers seeking to emulate patterns of natural disturbance could mimic the scale and patchiness of natural fir waves, like those shown on Mount Moosilauke, NH (l). These irregular bands of open canopy are usually separated by 100-175 ft and measure < 12 ac in total extent.⁴⁰ The disturbance interval in stands shaped by fir waves averages 60 years or less.⁴¹



Figure 8. Forest structure in a regenerating group cut with retained snags (l) closely resembles that of a naturally disturbed stand where the canopy has been opened by icing and high winds (r).

- If thinning is applied to stands < 25 ft in height, retain dense balsam fir patches > 0.5 ac and < 150 ft from the nearest unthinned patch or forest edge. If more than one pre-commercial treatment is planned, stagger the entries by 10 or more years.^{38,42}
- To protect soils and regeneration, harvest on dry or frozen ground, maximize trail-spacing, and restrict heavy machines to temporary routes and landings.

Infrastructure siting and mitigation

- When possible, locate new infrastructure in areas that have already been developed or where mature hardwoods make up at least one-third of the forest canopy.
- Minimize the size of permanent openings in chronically or recurrently disturbed forests, which are most likely to occur along exposed ridgelines, on west-facing slopes, and in areas subject to fir waves.
- Restore temporary openings or the unused margins of permanent openings (Fig. 9) through passive reforestation or high-density, native planting. If possible, transplant seedlings from highly stocked, nearby stands.
- Prepare the soil if it is not adequate to support regenerating trees, bearing in mind that red spruce is more likely than balsam fir to become established in full sun and on mineral soils. If soil amendments are needed, use local sources and avoid introducing invasive plants.
- Erect and maintain barriers and/or educational signage to protect restoration zones from vehicle, foot, and skier traffic.



Figure 9. Restoration of forest along road margins helps minimize the permanent footprint of high-elevation infrastructure.

- Maintain fir-spruce thickets in 10-20 ft-wide bands along the edge of permanent openings. A gradual increase in tree height from the opening to the adjacent forest may improve nesting cover.
- Maximize the size of forest patches between ski trails and limit trail width to < 150 ft (Fig. 10).
- Create new glades only in hardwood forests. In existing glades, minimize understory removal and ensure continual recruitment of seedlings and saplings to older age classes.
- Post, monitor, and enforce restrictions on unauthorized creation and maintenance of glades or other ski trails.
- Adhere to the US Fish and Wildlife Service's voluntary guidelines for the siting and lighting of wind turbines and transmission towers.⁴⁴
- Minimize the developed footprint of wind energy installations by micro-siting turbines and using narrow-tracked cranes, when possible.
- Mitigate permanent forest removal through reforestation of nearby anthropogenic openings. Capitalize on opportunities to consolidate small habitat fragments into blocks > 0.5 ac.



Figure 10. Bicknell's thrushes regularly utilize densely structured forest edges and are known to cross trails and roads < 150 ft wide.^{28,43}

General Recommendations

- Minimize earthwork and forest clearing for skid trails, haul roads, ski trails, crane pads, and service roads. Utilize existing access routes, when they are available.
- If possible, avoid timber harvesting and road construction in likely Bicknell's thrush habitats during the nesting and fledgling periods (June 1 through Aug 15). Seasonal limits do not apply to maintenance of roadbeds and are not as critical in stands that lack dense understory structure.

Managing for Multiple Benefits

Associated species

More than fifty species of vertebrate wildlife use montane fir-spruce forests in the Northeast.^{28,45,46} This group is comprised largely of migratory birds such as winter wren, magnolia warbler, and yellow-rumped warbler, but it also includes a small number of resident birds (*e.g.*, spruce grouse and gray jay), mammals (*e.g.*, American marten, porcupine, snowshoe hare), and amphibians (*e.g.*, northern spring and mountain dusky salamanders). Maintaining the landscape- and stand-level features that support Bicknell's thrush could benefit at least twenty Species of Greatest Conservation Need (Table 1).

Table 1. A partial list of Species of Greatest Conservation Need that could benefit from implementation of these guidelines. Species of high regional concern are indicated in bold. Species co-occurrence varies across the region.

| |
|---------------------------------------|
| American three-toed woodpecker |
| Black-backed woodpecker |
| Blackpoll warbler |
| Boreal chickadee |
| Canada warbler |
| Fox sparrow |
| Gray jay |
| Olive-sided flycatcher |
| Purple finch |
| Ruby-crowned kinglet |
| Rusty blackbird |
| Spruce grouse |
| Swainson's thrush |
| White-throated sparrow |
| Yellow-bellied flycatcher |
| American marten |
| Canada lynx |
| Long-tailed or rock shrew |
| Rock vole |
| Northern spring salamander |



Olive-sided flycatcher



White-throated sparrow



Rock vole

Ecosystem Services

Stewardship practices that maintain the integrity of high-elevation ecosystems yield a variety of benefits to society beyond the conservation of wildlife. Mountain forests capture, filter, and deliver clean water to downstream communities, while moderating stream flow and reducing the severity of floods. They provide opportunities for skiing, hiking, and other outdoor activities that promote human health and well-being. And they create business and employment opportunities in the tourism, recreation, and retail sectors. In addition to anchoring local economies, mountain forests of the US Northeast play an important role in stabilizing the climate. Northern Appalachian and Adirondack forests contain the region's largest stocks of sequestered carbon⁴⁷ and are expected to moderate the long-term ecological effects of climate change. Elevation- and latitude-spanning forests are particularly valuable for enabling future migration of plant species and the stable transformation of natural communities over time.

Comprehensive planning

When implementing recommendations for conserving Bicknell's thrush, land managers should weigh the potential effects of their decisions on other forest values and species of concern. For example, conversion of older forests to young stands may adversely affect mature forest associates, such as American marten and black-throated green warbler, unless measures are taken to sustain older stands in the surrounding landscape. Regional conservation partnerships and managers of large timberlands can deliver a broad

range of wildlife benefits concurrently by shifting through a mosaic of cover types and age classes over time and managing ecologically sensitive areas as reserves. This approach also strengthens the wood products industry since it conforms with forest certification standards and sustainable financial practice.

Wherever Bicknell's thrushes breed, local understanding of conservation issues and forest dynamics will help ensure sound management decisions. Forest and wildlife stewards who assess effects of their decisions and adjust practices accordingly are in the best position to achieve their conservation objectives.

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INTERNATIONAL
BICKNELL'S THRUSH
CONSERVATION GROUP



Field Guide to Forest Management for Bicknell's Thrush

Companion to *Guidelines for Managing Bicknell's Thrush Habitat in the United States*



Bicknell's thrush resembles several other woodland thrushes and can be distinguished most reliably by song. Note also the gray cheek, olive-brown back, and absence of spectacles seen on co-occurring Swainson's thrushes.

Status: Species of Greatest Conservation Need in NY, VT, NH, and ME

Habitats: High-elevation balsam fir-paper birch-red spruce forests in the northeastern US and adjacent areas of southeastern Canada. Nests in dense conifer thickets, along forest edges, and in sapling stands of mixed composition. May prefer areas with abundant snags and patches of forest in different age classes.

Home range size: Highly variable, averaging 8-13 ac for females and 13-30 acres for males, whose ranges often overlap.

Nest: Constructed mainly of fir twigs and sphagnum moss on 1-4 horizontal branches against the stem of a small tree. Placed 2-30 ft above the ground; most often between 5 and 7 ft in mountain forests. Interior cup lined with horsehair fungus.

Diet: Primarily beetles, ants, flies, and caterpillars captured on or near the ground by probing, pecking, or gleaning; berries of fruiting shrubs and small trees, such as mountain ash and elderberry, when available

Associated species: Varies geographically and includes black-backed woodpecker, blackpoll warbler, boreal chickadee, Canada warbler, gray jay, magnolia warbler, Nashville warbler, olive-sided flycatcher, purple finch, ruby-crowned kinglet, spruce grouse, Swainson's thrush, white-throated sparrow, winter wren, yellow-bellied flycatcher, American marten, Canada lynx, long-tailed shrew, rock vole, mountain dusky salamander, and northern spring salamander

Recommended forest management practices: When conducted in the appropriate context, some methods of timber harvesting can enhance conditions for Bicknell's thrush. However, conservation benefits may be low in areas where suitable habitat occurs naturally. For more information, please consult the complete guidelines.

| Starting Condition | Objective(s) | Management Options | Desired Condition |
|------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Mature fir-spruce forest with high canopy cover and sparse to moderate understory | Open canopy and increase light to the understory Create within- or between-stand patchiness Enhance important within-stand features | Clearcut with reserves Group shelterwood Group selection (0.5-2 ac) Expanding-gap group shelterwood Retention of snags and low-vigor trees, fruit-bearing trees, and regenerating conifers | A high density of conifer saplings and small trees form a thicket > 6 ft in height Canopy is open or semi-open If present, canopy trees measure 15-30 ft in height Snags and/or fruit-bearing trees are present |
| Young fir-spruce forest with low canopy (< 25 ft) and high density of saplings and small poles | Retain dense understory structure and softwood dominance Create patchiness if thinning is applied | No thinning Variable retention thinning, w/ conifers left in patches | Sphagnum moss is present Forest structure is heterogeneous within and/or between stands |

Additional considerations

- Protect understory structure during harvest operations by harvesting on dry or frozen ground, minimizing travel, and maximizing trail spacing and machine reach.
- If practical, avoid felling and skidding during nesting and fledgling periods (Jun 1 to Aug 15).
- Retain dense conifer patches > 0.5 ac and < 150 ft from the nearest unthinned patch or edge.

Field Guide to Forest Management for Bicknell's Thrush



Bicknell's thrushes nest in regenerating fir-spruce stands dominated by saplings (>4,000 stems/ac).



Young mixed-woods may also be used for nesting, especially if softwood thickets, snags, and other open perches are available. Mountain ash provides high-calorie fuel for migration and should be retained, when practical.



In cases where pre-commercial thinning or partial harvests are used, variable retention (l) and staggered entries are recommended to promote the patchy structure typical of forests most preferred by Bicknell's thrush (r).